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ABSTRACT

This paper reports on the Macromedia Accessibility Project (MAP), a collaborative effort developed by Macromedia, Inc., The League for Innovation in the Community College, and Pima Community College, Arizona, in order to explore the questions and challenges of implementing accessibility standards in online developmental math courses in community colleges. The purpose of the project, as a two-part process, was to evaluate the capacity to create online mathematical content in an accessible format, and to identify the differences between updating content and design differences for Web-based courses versus creating new content and design features for Web-based delivery. Project team members were charged to audit and upgrade one existing online math course and create one new online math course. As a summer project commencing June 15, 2002 and ending September 15, 2002, the 3-month timeline called for inclusion of training sessions, groups meetings, and follow-up communications. Comments from MAP team developers were summarized for review. This paper describes the two different processes teams went through in the course revisions and the new course development. The MAP team members completed all project goals and objectives as designated, yet noted that their work barely scratched the surface. Includes 5 figures and recommendations for further research. (NB)

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Macromedia Accessibility Project (MAP)

by Stella Perez

November 2002

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Macromedia, Inc.
600 Townsend Street
San Francisco, CA 94103
415-252-2000

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Information technology–and especially the rapidly-expanding capabilities of the Internet–holds tremendous potential for providing students with access to knowledge and educational opportunities that were not previously possible. Accessibility ensures access to electronic information for all users, including those with disabilities. Accessibility is a crucial issue for community colleges, not only because federal, state, and local policies mandate making electronic information available to all users regardless of disability, but because openness is an integral part of the community college's mission. With their goal of making education available to all, community colleges have a crucial stake in ensuring that, as educational channels expand to include web-based communication and online course offerings, equal opportunity is not compromised. This paper outlines a three-month project that was conceived as a collaborative effort to promote information regarding accessibility and to integrate this information into the online curriculum of one community college.

Macromedia Accessibility Project (MAP): A Collaboration of the League for Innovation in the Community College, Macromedia, Inc., and Pima Community College

American history is filled with the names of great people who are recognized as having some form of disability. From George Washington with his cognitive learning disabilities (he could barely write and had very poor grammar skills) to Woodrow Wilson, who was severely dyslexic, to Franklin Roosevelt, afflicted with physical disabilities and paralyzed by polio at age 39, our history is one of notable figures overcoming significant obstacles; however, our short history of public policy and development of services for people with disabilities dates back only as far as 1986, when Congress added Section 508 to the Rehabilitation Act of 1973. The Rehabilitation Act contains comprehensive prohibitions against employment discrimination on the basis of disability by the federal government, by contractors for the federal government, and by programs and activities receiving federal financial assistance.

In this new millennium, the explosion of technology and the use of the Internet have dramatically changed the way we live, work, and learn. To match these transformations, America's educational structure is also being reshaped, redesigned, and redefined by computer-based resources, distance delivery, and a new age of information access.

The history of public education supports the nation's fundamental belief in access and opportunity for all. The open doors of the community college symbolize democratic principles and the concepts of lifelong learning. The exciting new approaches to learning and working created by the Information Age seem inherently to support these community college values. The Internet has opened access to limitless information sources and changed both the rate and pace of data acquisition. Online learning and telecommunications systems have taken on new meaning as individuals seek references, connect with colleagues, or acquire diplomas from their desktops. The Internet is estimated to have more than 200 million worldwide users, with projections of growth to more than 500 million by the year 2003. More than two million online courses and 3,000 degree programs are offered through distance learning delivery (www.YIL.com, 2002). These advances are rapidly expanding new options for learning and changing forever the role of the traditional brick-and-mortar schoolhouse as the primary access point for education.

Despite these seemingly limitless learning options, the community college ideal of open access remains a dream deferred. Growing evidence indicates that, in addition to historic race, gender, and socioeconomic factors, issues of disabilities, access, and technological expertise exacerbate the growing divisions between rich and poor (Reich, 2000).

The "Digital Divide," or the division of haves and have-nots in a technology-based society, manifests itself in many ways—often including a lack of accessibility by regionally underserved populations and at-risk individuals. With the increase of technology-assisted learning on our nation's campuses, gaps in service and accessibility have emerged in online and technology-enhanced learning offerings for students with disabilities. Community colleges have taken steps to comply with Section 508 of the U.S. Rehabilitation Act; however, improved access for online learners with disabilities at community colleges is often hampered by challenges such as: (a) the need for targeted outreach to disabled individuals pertaining to online and technology-enhanced learning options; (b) inadequate training and a lack of awareness about issues affecting students with disabilities; (c) a lack of familiarity with web development that addresses accessibility; (d) inadequate access to skilled technical personnel to support development of accessible online and technology-enhanced courses; and (e) inadequate support for students with disabilities as well as for faculty and staff serving online learners with disabilities.

One out of five Americans age 16 and over has a disability of some kind. Students with disabilities (which may include visual, hearing, cognitive, or motor impairments) comprise 11 percent of pre-K-12 and 7.2 percent of beginning postsecondary students. Within the overall pool of college students, a greater percentage of students with disabilities attends two-year schools than four-year schools, compared with their nondisabled peers.

In June of 2001, President Bush affirmed his commitment to Americans with disabilities and signed into action new implementation policies and state mandates for Section 508 standards, especially as they relate to computers, communication devices, and the availability of assistive technologies. As the Section 508 standards state, "Accessibility features are required to be built in, or be compatible with assistive technology devices." A series of provisions to Section 508, along with recommendations and examples, are offered to make software and web pages compatible with assistive technology. With fast-approaching deadlines for compliance with the new Section 508 technical standards, many educational institutions are grappling with how best to enhance accessibility for students through telecommunications, multimedia products, and web-based curricula and services.

Macromedia Accessibility Project (MAP)

In June of 2002, Macromedia, Inc., the League for Innovation in the Community College, and Pima Community College (AZ) initiated a collaborative venture to explore the questions and challenges of implementing accessibility standards in online developmental math courses in community colleges. The newly released Macromedia Studio MX (May 2002), with new features and interfaces to support accessibility standards, was selected as the course development software.

Project Goals

The purpose of the project, as a two-part process, was to evaluate the capacity to create online mathematical content in an accessible format, and to identify the differences between updating content and design features for web-based courses versus creating new content and design features for web-based delivery. Project team members were charged to:

1. Audit and upgrade one existing online math course to comply with Section 508 standards; and
2. Create one new online math course in compliance with Section 508 standards.

Macromedia Studio MX

Studio MX is a visual development environment for designing, coding, and managing dynamic websites. Studio MX sets a new standard for accessibility in web development tools with unique and full support for accessibility reporting, active authoring modes for accessibility, and an accessible application environment. Dreamweaver® MX enables developers to design and code the full spectrum of accessibility solutions from websites to Internet applications, without compromising the market-leading product's ease of use for building simple HTML sites.

The American Association of People with Disabilities, Knowbility, Inc., Lighthouse International, the National Center for Accessible Media, and the National Federation of the Blind have offered notable praise to Macromedia, and more specifically Dreamweaver MX, for development features that include accessibility-specific site reporting, reference content, and tag editors. Also embedded within the development applications are options to increase the font size, enable keyboard accessibility, and support screen readers.

New website reporting features enable developers to create reports that ensure that web pages meet accessibility guidelines by pinpointing problems quickly and easily. Studio MX provides benefits to course developers and programmers, including on-screen prompts that highlight accessibility-related tag attributes and provide tag editing to ensure that program code is compliant. Studio MX also provides increased support for developers who use assistive technology, such as screen readers, to improve the usability of their assistive technology software. The software has also been tested for support of both the JAWS screen reader from Freedom Scientific and the Window-Eyes™ screen reader from GW Micro. Studio MX software is keyboard-navigable, including shortcuts and panel manipulations, and features a new large-fonts option that makes panel and dialog fonts easier to read at higher resolutions.

Project Activities

The MAP timeline, June 15 to September 15, 2002, dictated fast-paced communications, planning, and implementation. After faculty developers were selected, the three-month summer break offered team members the opportunity to focus on training and course development prior to busy fall and spring semesters. Recognizing the formative development and experimentation of *Action Research*, where the purpose is to inform action, enhance decision making, and apply knowledge to address human and social problems (Patton, 1990), project team facilitators outlined an open model of experimentation and exploration. In light of *Action Research* principles, project activities were guided by designated timelines, commitment to pre-defined roles and responsibilities, and formal *exit plans* as follow-up to training sessions.

Course Selection

Developmental students are not new to academic institutions, and leading developmental education researchers adamantly stress, "The problems associated with developmental or remedial education in open-door colleges will not go away" (Roueche & Roueche, 1999, p. 14). Within these programs a positive correlation exists between students enrolled in developmental courses and students with disabilities (Berger, 2002). Mathematics was chosen as the best subject for MAP, as it is considered a subject area in great need of developmental studies and because math content and measurements are relatively well defined. Pima Community College has four levels of online mathematics courses: Pre-Algebra, Elementary Algebra, Intermediate Algebra, and College Algebra. The courses selected for MAP were MAT 086–Pre-Algebra and MAT 142–Topics in Mathematics. As MAT 086 has some of the highest enrollments of any course and was previously prioritized by the college for revision, it was a natural selection for update with accessibility features.

The second course, MAT 142–Topics in Mathematics, was selected for a broader variety of reasons. First, the course is a "mathematical capstone" experience for many Liberal Arts students, who are typically weak in mathematics and have no further math requirements for an Associates Degree. In addition, MAT 142–Topics in Mathematics is considered a developmental math course at the four-year university level, and the project team chose to experiment with providing an online experience that meets the needs of existing, transfer, and concurrently enrolled college students. Also, the MAP team recognized that many Liberal Arts students become teachers; therefore, the MAT 142 course could potentially serve as a model and reference for future teachers in their experiences with students with disabilities. Finally, MAT 142–Topics in Mathematics is a course that surveys many mathematical topics. The variety of math symbols used in this course allowed for the expansion of expertise in Mathspeak, a language whose use is growing among interpreters for the blind.

Roles and Responsibilities

Clear delineation and communication on designated roles and responsibilities of MAP team members were the first steps of project initiation. Using an inverse approach–working backward from the MAP outcomes and deliverables–team members established specific criteria to meet timeline goals and course development standards of quality. The collaboration required the three partners–League for Innovation, Macromedia Inc., and Pima Community College participants and administration–to commit to provide hardware, software, training, services, and intellectual capital toward project goals. The roles and responsibilities were developed prior to the selection of the full MAP team membership and openly discussed as part of the first conference call among participants. Examples of the project processes designed to guide MAP team members' roles, activities, and responsibilities toward project goals included:

MACROMEDIA PROJECT LEAD

- Software and licensing of Studio MX for MAP team members
- Customized audit of existing online course to be evaluated during MAP
- Two training sessions for MAP team members

LEAGUE PROJECT DIRECTOR

- Project plan–process, implementation, and resource development
- Coordination and participation in MAP conference calls, meetings, and training sessions
- Assistance with course redesign, analysis, and evaluation

PIMA COMMUNITY COLLEGE MAP TEAM

- Training and implementation of Studio MX software
- Course design reports–discussion of *learning curve* related to software, template development, and accessibility issues
- Faculty logs–documenting development processes, new ideas, and challenges

Project Timelines and Training Sessions

As a summer project commencing June 15, 2002 and ending on September 15, 2002, the three-month timeline called for the inclusion of training sessions, group meetings, and follow-up communications.

Macromedia scheduled and sponsored two training sessions. The first was conducted by Bob Regan, Senior Product Manager, Macromedia, and Greg Konop, Information Processing Consultant for Professional & Technical Education, University of Wisconsin-Madison, in July 2002. The second session, held in July 2002 at Pima Community College, was led by Alan Foley, Assistant Professor of Education, University of North Carolina. The training began with broad and in-depth explanations of current accessibility standards set by federal legislation and guidelines. The trainers shared online sources for information about regulations and detailed explanations of their development and scope, to include World Wide Web Consortium (W3C) legislation, the Americans with Disabilities Act (ADA), Section 508 policy and principles, Section 504 policy and principles, and the Institute for Distance Education (IDE).

Through discussion it was determined that the program objectives would use Section 508 standards as a minimum. Section 508 offers some of the clearest policy language for individuals with disabilities and therefore simplifies measuring outcomes and progress. The trainers' serious dedication to accessibility set the tone for project implementation and helped faculty participants understand the importance of the issues facing individuals with disabilities. During the two-day training session, MAP team members were primarily introduced to the accessibility features of Dreamweaver MX, with some attention to Macromedia Fireworks® MX. Even with limited experience in web development and minimal knowledge of Macromedia software among some members of the MAP team, all were able to follow the trainers' directions and keep up with the content development. While the software is highly functional, it is also relatively intuitive, and the trainers were able to offer design guidelines (such as size of banners and file extensions) and shortcut features. The trainers' expertise and guidance saved many hours of development, testing, and error.

As MAP team members advanced through each step of course development, the Macromedia trainers offered tips, ideas, and shortcuts necessary to check for content accessibility, planning particularly for use with a screen reader. The trainers also highlighted and defined the concept of ***accessibility*** versus ***usability***. In designing a site, ***accessibility*** ensures that the site *can* be used by a person with a disability. Accessibility standards such as those maintained under Section 508 or the W3C guidelines include numerous checkpoints to ensure that pages will work for people using assistive technologies. Going one step further, ***usability*** is an effort to ensure that a site is *easy* for a person with a disability to use. As one example, designers will often include a hidden link at the top of a page called a *skip navigation link*. This link allows a blind person using a screen reader to skip directly to the content of the page, rather than listening to the navigation links at the top of every page. While a website may meet W3C guidelines and be considered accessible, it may still be tedious and difficult to use without usability features such as skip navigation links.

The trainers also referenced and shared a number of online validation tools. Some of these tools were automated, such as the tool built into Dreamweaver MX or the popular online tool known as *Bobby*. The trainers also recommended the use of technologies such as IBM Home Page Reader to test accessibility and techniques such as navigating using only the keyboard to evaluate a site as it might be used by people with disabilities. They pointed out that combining automated and hands-on approaches to validation would result in the most accessible and usable site designs.

A written *exit plan* was disseminated and discussed at the close of each Macromedia training session as a formative plan for project processes. The exit plans outlined phases of development, reiterated MAP team members' responsibilities, designated Macromedia support resources, and included conference-call dates for follow-up discussions.

Course Design Reports

Comments from MAP team developers were pattern-coded and summarized for review. Although there are many similarities between revising an existing course with accessibility features and creating a new course with accessibility features, the special development functions and content application warrant separate reference.

Course Revision

The first step toward course revision was complete review of the content elements and correlated curriculum of PCC's Prealgebra (MAT 086) course. The course design was complete, and the assigned instructors were populating it with content. In 2001, Pima Community College adopted WebCT™ as their standard course management system for online delivery. All MAP processes included download, conversion, and implementation through the WebCT delivery system.

After content review, MAP faculty then began evaluating pages for untagged images and adding *alt tags* as needed. Tagging images and adding alt tags allows alternate text images to be interpreted by text-only assistive devices such as screen readers. According to one Macromedia trainer, the most common barrier to HTML websites for users with disabilities is the infrequency or absence of image tagging; adding alt tags to website content as inclusive features makes the website much more accessible.

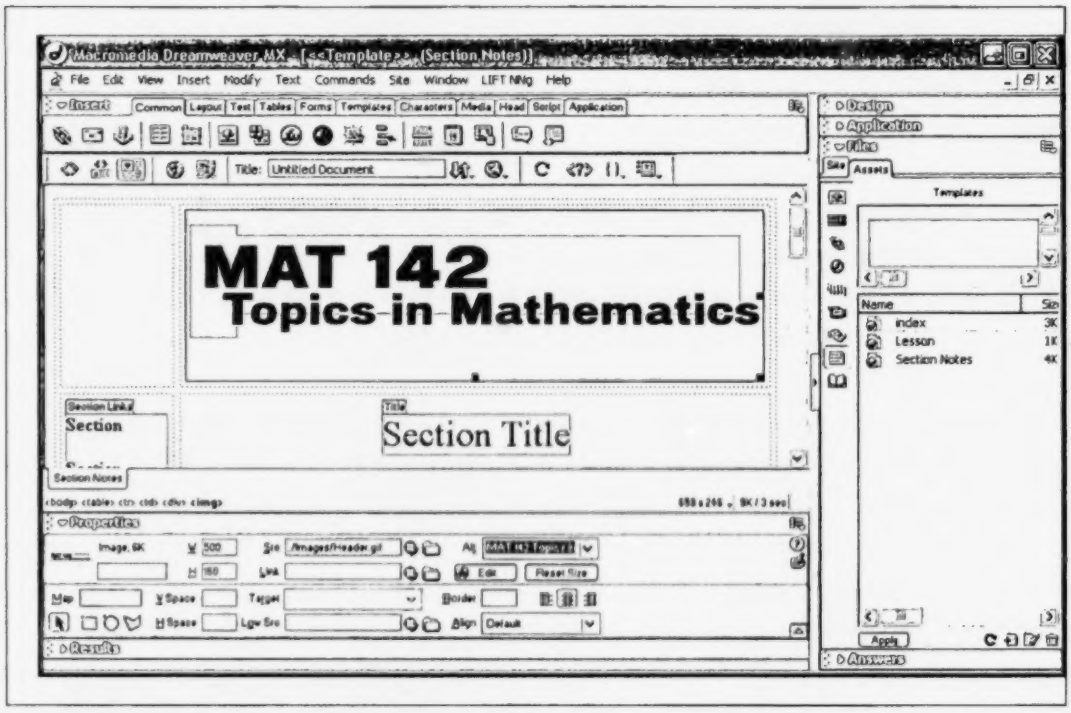

Figure 1: *Screen shot of Dreamweaver MX showing an image that is highlighted and an alt tag being added*

Process

From WebCT, faculty zipped pages or files and saved them to resident hard-drive systems. They then unzipped the web pages and imported the HTML files created using Dreamweaver MX. Among Dreamweaver's accessibility features is the option to review transferred and/or copied files and immediately evaluate accessibility through a formal report that highlights and flags accessibility errors. More important, the Dreamweaver reporting feature offers recommendations for editing content to comply with accessibility standards. As a concurrent function, Dreamweaver enables developers to switch from the design view to the code view on the toolbar. If the report identifies an image that requires an alt text tag, the designer can instantly add the alt text by writing a simple description of the image. Thus, Dreamweaver offers identification of accessibility errors and immediate steps toward remedying the problems.

After revising and saving the now-accessible web pages, MAP faculty were able to open the pages and view them in a browser (which can be done in Dreamweaver without exiting the software application). The pages were then tested using a screen reader–a downloaded version of IBM Home Page Reader was selected as an expedient option for reviewing and evaluating web page content and graphic elements embedded in WebCT.

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From the outset, MAP faculty encountered trouble attempting to include animations as accessible components. PCC's Prealgebra (MAT 086) had been designed to hold the attention of developmental learners and therefore included multiple animation files and movies. Using the accessibility features of Macromedia Flash MX, faculty were able to add alt tags to the animation files, using a unique file extension format (.swf versus the more common .fla) and solve challenges associated with delivery and download.

Figure 2: *Screen shot of Accessibility Panel in Macromedia Flash MX*

New Course Development

Through the training sessions, MAP team members learned how to build and manage HTML-based websites using Dreamweaver MX in conjunction with Macromedia Fireworks® as a production environment for creating, editing, and animating web graphics. Creating and designing websites was new to the faculty participants responsible for MAP new-course development efforts; although some had experience in writing content for web pages, connecting all links and loading content through other programs had seemed "clunky and not very intuitive." The Macromedia trainers, however, demonstrated the ease and importance of integrating accessibility standards through formative processes of web design.

Process

Although new content development is in some ways similar to course revision, critical development features of Studio MX offer new content developers the ability to generate accessibility reports and evaluate web page compliance with Section 508 standards as content is loaded. Training sessions offered a valuable understanding of background design features, such as file compression–the ability to minimize graphic file sizes–and the impact of this feature on the reduction of download time for accessibility hardware components such as screen readers and auditory devices. Techniques used to reduce the file sizes of newly developed MAT 142 web pages included optimizing pictures, cropping unneeded portions, and creating thumbnail versions of the images.

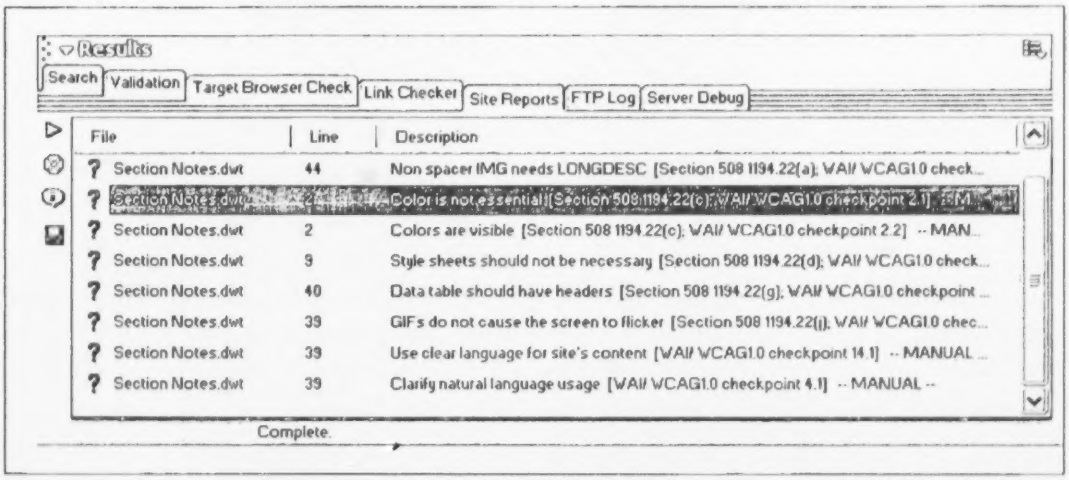
Results
Search
Validation
Target Browser Check
Link Checker
Site Reports
FTP Log
Server Debug
File
Line
Description
Section Notes.dwt 44 Non spacer IMG needs LONGDESC [Section 508 1194.22(a); WAI/ WCAG1.0 check...
Section Notes.dwt Color is not essential [Section 508 1194.22(c); WAI/ WCAG1.0 checkpoint 2.1] -- M...
Section Notes.dwt 2 Colors are visible [Section 508 1194.22(c); WAI/ WCAG1.0 checkpoint 2.2] -- MAN...
Section Notes.dwt 9 Style sheets should not be necessary [Section 508 1194.22(d); WAI/ WCAG1.0 check...
Section Notes.dwt 40 Data table should have headers [Section 508 1194.22(g); WAI/ WCAG1.0 checkpoint ...
Section Notes.dwt 39 GIFs do not cause the screen to flicker [Section 508 1194.22(j); WAI/ WCAG1.0 chec...
Section Notes.dwt 39 Use clear language for site's content [WAI/ WCAG1.0 checkpoint 14.1] -- MANUAL ...
Section Notes.dwt 39 Clarify natural language usage [WAI/ WCAG1.0 checkpoint 4.1] -- MANUAL --
Complete.

Figure 3: *Screen shot showing Results panel in Dreamweaver MX*

Another important accessibility feature of Studio MX is the capability to integrate text and pictures using Cascading Style Sheets (CSS) and templates. CSS features allow web pages to be viewed and modified by the end user. Templates are useful when importing text from other programs. Using templates in Dreamweaver allows developers to integrate design components, including banners, alt text tags, and standardized features. This is an efficient and timesaving function when developing 20 to 30 similar yet unique web pages.

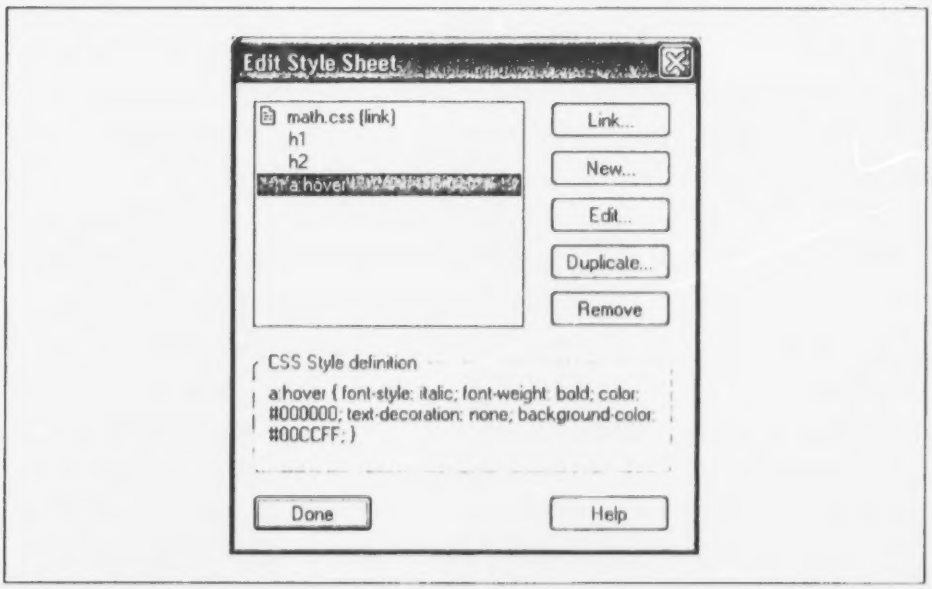

Figure 4: *Screen shot showing CSS Editor in Dreamweaver MX*

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Lessons Learned and Recommendations for Future Development

Although the Studio MX software features are formidable, MAP participants agreed that one of the most valuable project experiences was learning about–and being involved in–the development of accessibility features for individuals with disabilities. One MAP faculty member commented, "The most important and worthwhile project training component was the information on accessibility." The project enlightened participants on much more than mere software training, and MAP team members concurred that, armed with detailed information on Section 508 standards and the W3C guidelines, coupled with the features of Studio MX, they can create websites that are creative, captivating, and exciting while easily meeting the standards for accessibility.

Outlined below are MAP team members' ideas and lessons learned, for those interested in replicating successful accessibility features in online course content.

- Initial efforts to integrate files created using Dreamweaver through WebCT resulted in one team going "back to the drawing boards" and rewriting template parameters. It is important to note standard navigation features of course management systems or online delivery systems such as WebCT to avoid design flaws and/or duplication of web page information functions.
- The benefits of using Dreamweaver templates and CSS are greater when trying to integrate third party software as content and design elements. As part of MAP, one team member used Design Science Math Type, a software tool for creating math symbols and equations. The current version converts text equations into gifs (graphic interface files). The gifs allow the user to enlarge an equation for better viewing and printing, thereby benefiting students with visual impairments; however, conflicts arose between the conversion and integration of the images, and it was decided that the pages should be rewritten as HTML files created using Dreamweaver MX. Fortunately, using Dreamweaver MX, text could be copied and pasted within a new template design, and Cascading Style Sheets offered automatic adjustment to new accessible design functions, maximizing efficiency and minimizing programming and development efforts.
- MAP team members discovered challenges using Macromedia Flash files for captioning when the files were previously composed as layers. As a workaround, MAP faculty discovered that Flash files could be converted into static image files and then updated with new content. An individual designing a new course should add the accessibility tags to Macromedia Flash animations while in production, rather than after the fact.
- During the course of project development, MAP faculty learned that the National Center for Accessible Media (NCAM– http://ncam.wgbh.org/) offers a variety of free accessibility resources and software plugins for download, including a captioning tool for Macromedia Flash files.
- One of the challenges for MAP course evaluation was program crashes during attempts to use the Jaws and Window-Eyes screen readers. MAP faculty had better luck using a downloaded version of the IBM Home Page screen reader (http://www-3.ibm.com/able/hpr2.html). After discussion with IT staff, MAP team members attributed the program crashes to the robust nature of the other software programs and the technological capacity of systems with regard to RAM, hard drive space, and concurrent use of multiple software applications.

- MAP faculty offered a software development recommendation related to entering text into alt tags. Currently, Studio MX does not offer a spellcheck feature to check the spelling of text within alt tags. Although the dictionary is always a solution, most developers and technically adept individuals' expectations include software spellcheck options.

Summary of Experiences

Online course curriculum and content are in a constant state of expansion and change, with the addition of new knowledge and technological advances. The MAP team members completed all project goals and objectives as designated by timeline and deliverables. This noted, MAP team members believed that their work "barely scratched the surface of accessibility in online course development."

MAP team members underscored the need for training and policy development for accessibility in the following comments:

> *The best thing to come out of this project has been the awareness that I have developed with regard to disabilities. I now never write a web page without thinking about accessibility issues. My web pages are cleaner and easier to navigate. I now create web SITES rather than web pages, and templates and style sheets are making life much easier for me. The methods I've learned to help individuals with disabilities have actually improved my work.*

> *Writing math content for the web can be challenging and time consuming, but the project offered an invaluable experience of writing accessible online math content with a whole new awareness and dimension of learning.*

MAP team members felt that, as with many software packages, there was much more to learn and they had only *scratched the surface* with regard to utilizing the capabilities of Studio MX. MAP team members agreed that the built-in features of Studio MX offer easy opportunities for faculty and other developers to learn and create readily accessible websites.

The following MAP faculty member comments further elaborate on the positive benefits of training:

> *I have to congratulate Macromedia on being the first company to address the issue of accommodating those with disabilities. [Studio MX] helps faculty such as myself not to forget Section 508 issues.*

> *For those with more web development experience, these tools should be helpful in allowing them to maintain accessibility while using more challenging design elements. For years, MAP team members have heard designers bemoan the need to keep high contrast and simple elements in their web pages so that accessibility can be achieved. The [MacroMedia] tools won't obviate those needs; but they give designers more options.*

The experiences I've had and skills I've gained in this project have provided a ground on which to build. I have a great deal more to learn and do. I plan to share what I've gained with colleagues here at PCC and elsewhere. Most importantly, I know that I will continue to think about accessibility issues and will work to remove barriers to access to educational opportunities. This concept is close to my heart to begin with; it's the reason I chose to work in education, and specifically distance education.

Recommendations for Further Research

There are many ways of going forward, but only one way of standing still.

–Franklin D. Roosevelt

Behind the summary, comments, and quotations of this project lie the hard work, dedication to innovation, and commitment to learning shared by the corporate partners, administration, faculty, and MAP project team members. Although the project traces the ideas, progress, and outcomes of initiating accessibility standards in one college's online course development, it also demonstrates the need to elevate the issue of accessibility within higher education, and encourage participation in the development and implementation of accessible specifications for distributed learning platforms. National training projects and future studies should include larger sample sizes of faculty development, targeted regional resources and service providers, and longer project duration to allow for evaluative comparisons of student access, feedback, and success. Furthermore, the MAP outcomes demonstrate the critical importance of strengthening the policies and capacity of community colleges to create and deliver accessible curriculum and learning content in a technology-enabled format. Future studies should support larger-scale comparisons of new course content developed in accordance with accessibility standards.

Finally, it is important for future research efforts in accessibility to examine more than developmental education, since consideration for the special needs of individuals with disabilities should be part of the investment in the futures of our colleges, our communities, and our country. If community colleges are to journey from the confines of the campus classroom and college computer labs to the anytime-anyplace opportunities of distance learning, it is imperative that studies like MAP chart the course for accessible content and systems that improve the quality of learning, teaching, and work life for all.

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